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The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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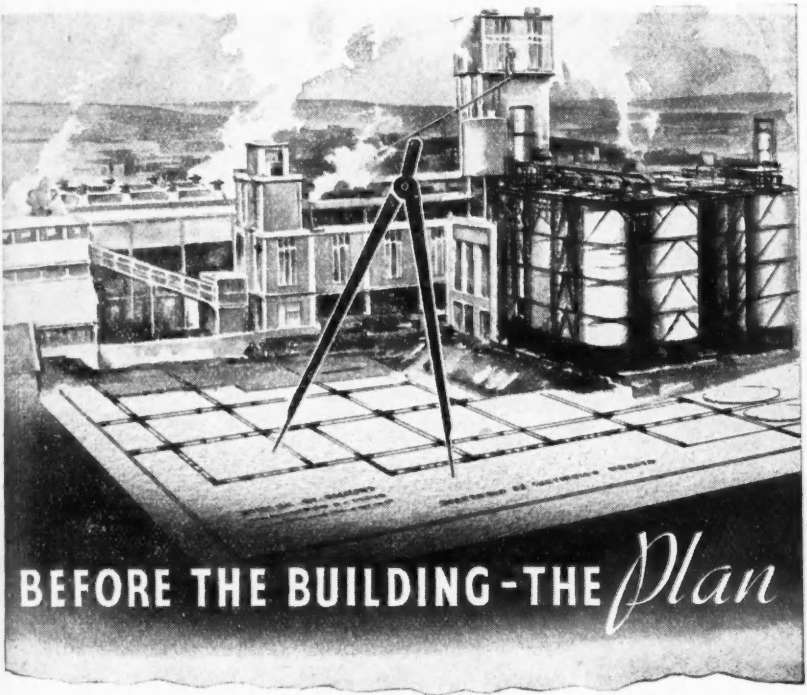

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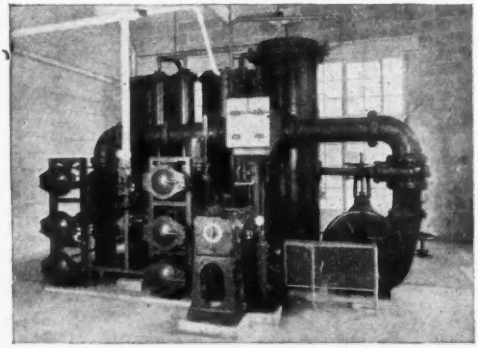

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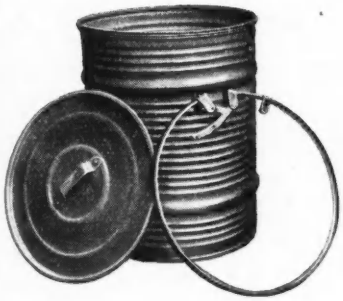

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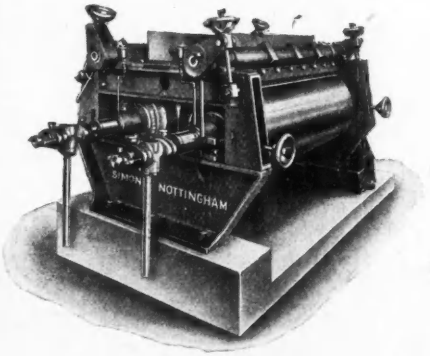

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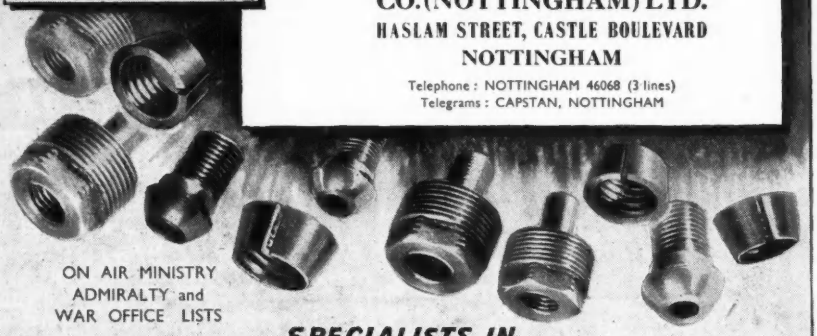

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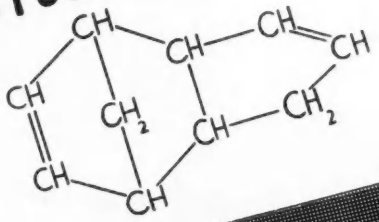

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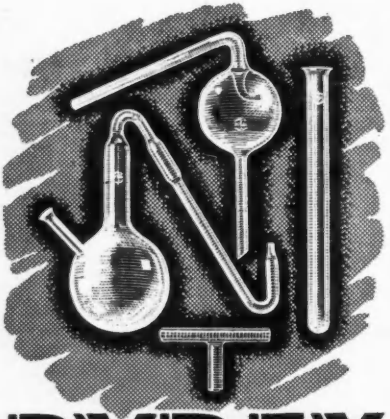

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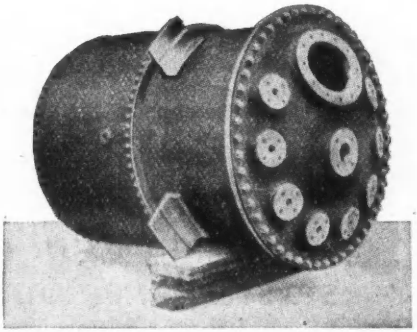

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Outcrop Coal

THE shortage of coal, which has been so prominent a feature of the past two years, does not get much better; if anything it gets worse, and every works engineer knows that if he is to get through his normal works output without disaster on the coal allowed him, the greatest economies must be practised. What steps are to be taken to promote these economies will be found in the excellent and informative technical bulletins issued by the Ministry of Fuel and Power—the excellence of these publications being no doubt largely due to the fact that they are drawn up by advisory panels of outside experts having wide knowledge of fuel technology.

There seems to be some difference of opinion among experts, however, as to the position of steam utilisation. On the other hand, we are told that in most industries industrialists do not know much about steam utilisation, while the experience of others is that though there may be a lack of appreciation of the problems of combustion, there is no lack of knowledge on steam practice. As the Ministry is issuing a set of bulletins on steam practice also, whichever view may be correct matters very little, provided that everyone will read what literature is supplied for his illumination. The game of making the coal allocation stretch to cover production is complicated by variations in the quality of coal. When a works could rely on having the same coal week after week—often, when using mechanical stokers, the coal recommended by the makers—there was no difficulty in evolving a technique for burning it satisfactorily. It is true that there might be imperfections in the boiler plant, but at least the coal was burnt reasonably well. Then came the scramble for coal in which all works not on the highest priority had to take what they were given, and make the best of it. That is when the engineer with a knowledge of fuel technology comes into his own. It is quite difficult to ascertain in advance what sort of coal has been sent and to say unfailingly what technique should be used for burning it.

Consequently, all manner of trouble has arisen—trouble which has demanded the assistance of the Ministry's engineers, or of the regional engineers, or of one's own fuel efficiency committee. The mysteries of draught regulation, of primary and secondary air, of air infiltration, thicknesses of fuel beds, and so forth, had to be explored. Ultimately,

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most works found out how to use whatever coal they have been sent.

The last straw, in the opinion of many engineers, was the coming of outcrop coal. Those who remember the coalfields during the strikes of the 1920's will recollect seeing miners on strike digging pits from the surface some 20 yards or so into the ground; from the base of these pits coal was hewn which was sold locally to all who cared to buy it. That was known as outcrop coal, and was generally pretty poor stuff. Strictly, it was not true "outcrop" coal, though it was near enough to the surface to partake of the properties of that coal. Now that the supply of coal has become short, steps have been taken officially to mine true outcrop coal by the simple method of open-cast working. This method is to start where the coal seam comes to the surface—often on rising ground in a valley—and to win the coal by the simple method of removing the overburden and digging it out. This method does not require skilled labour, and thus has the advantage of increasing output without calling on the skilled miner. Not unnaturally, many works have been required to take a proportion of their coal allocation in the form of outcrop coal, or, as it is often called to-day "open-cast" coal. This, being of a different character to the general run of coal, caused difficulties and led to complaints.

It is well to analyse the problem by inquiring into the nature of outcrop coal. When coal is stored it "weathers," which in ordinary language means that it partially combines with the oxygen of the air and so changes its chemical composition. In the early stages of weathering oxygen is absorbed and later carbon dioxide and water vapour are evolved as the temperature rises a little. The coal seems to form more complex compounds with oxygen which later decomposes. There are, of course, other changes if the coal heats and ultimately fires, but these need not concern us in discussing outcrop coal. The coal loses a little carbon and hydrogen in this way, but probably very little. Its calorific value is not affected appreciably. Under normal conditions of weathering, a very strongly coking coal does not seem to lose its coking properties easily, but if the weathering is continued for many years, even the best coking coals will lose their coking powers. A change of great importance to the combustion engineer is that weathered coals become friable and often break down to slack on handling. Even three or four years' storage may result in the formation of quite a lot of slack. This slack may cause troubles in burning and makes it appear that the coal has decreased in calorific value. When a coal seam crops out on to the surface, the layers at and near the surface are freely exposed to the air, and thus become weathered. The first few yards in from the outcrop may be so highly weathered that the coal cannot be mined without crumbling to powder. Like most weathered coals they are completely non-caking, and will contain large amounts of hygroscopic water. They are thus of very poor quality, and are discarded. It is important to recognise, however, that as the coal seam gets farther from the surface, its quality shows a marked improvement. It would seem as though the air affects the coal slowly. Probably, the explanation is that coal and the clay which surrounds the seam are pervious to air only with difficulty, so that the air must slowly penetrate the coal, oxidise it, and make it porous before it can attack farther in. Whatever the reason, the fact remains that the farther in one goes from the surface, the better the coal becomes, so that much of the so-called outcrop coal now being mined is in fact virtually equal in quality to the same seam as mined in the pits. Finally—supposing the coal to have coking properties—a zone is reached at which, within a short distance of a few feet, the coal suddenly gains its full coking power similar to that mined in the pit. Put in the opposite way, the seam, as one proceeds outward from the mine to the bassett edge, suddenly loses its coking powers, this happening at a stage when there is very little loss of calorific value. From this point, as the bassett edge is approached, the C.V. decreases, slowly at first, and then rapidly in the immediate neighbourhood of the bassett edge. Since most outcrops have been driven well in by now, the quality of outcrop coal will probably not leave much room for complaint; and, if the peculiar properties of outcrop coal are recognised, there should be no difficulty in using it satisfactorily.

NOTES AND COMMENTS

A Little History

THE mandate of the Royal Society of Arts is a notably wide one, and its character and usefulness may be described as of a peculiarly English nature. In any event its services to industry are undoubted, and the wise industrialist will keep a weather eye open on its activities. The Society may fairly be said to represent informed public opinion on the progress and requirements of industry, especially in its relation to the public at large, and the pronouncements from the Chair at each annual inaugural meeting are never to be lightly dismissed. In particular, when an eminent chemist occupies the chair, it behoves industrial chemists to give heed to his words. For this reason, among others, we intend to publish in due course some extracts, regrettably brief, from Dr. Armstrong's address of this week. Particularly significant were his observations on the position of research, and especially on the public attitude to Science, which he viewed, as was appropriate, in its historical perspective. To some of us it may have come as a shock to hear that until comparatively recently the ruling classes took an indifferent, if not a supercilious, view of science; and this, at any rate, will help to explain the remarkable inertia that apparently has to be overcome before suitable expenditure can be made on scientific research. As we have often remarked, a short glance at history is often most illuminating.

Planning the Gas Industry

THE Gas Industry has submitted a report to the Minister of Fuel and Power on "The Planning of the Gas Industry," which clearly indicates its future plans for organisation and structure to be on evolutionary lines, rather than resorting to the revolutionary experiment of national control. Two years' research have gone into the drafting of this report, including a factual survey of the industry which was submitted to the Minister some weeks ago. This confidential survey formed a valuable basis for the post-war plans put forward in the report, and it is significant that the submission of this report has received the support of the whole industry. It does not represent merely the findings of a group of experts, but, following true democratic principles, has been circulated, discussed, and amended in the light of comments from all sections of the industry. This big public utility is confident that the contribution it will be able to make to the rebuilding of Britain's homes and industries after the war is one of vital importance. The chief recommendations of the report include (i) the formation of a British Gas Association to supersede various other national gas bodies now in existence and to assume their functions, with a Central Council to act as a "parliament" for the industry; and (ii) methods of integration of undertakings throughout the country to provide a better service to the community after the war and to hasten the extension of gas into rural areas. Furthermore, it puts forward a suggestion that the Ministry of Fuel and Power should appoint a National Fuel Advisory Council to facilitate the elimination of wasteful competition between the fuel industries, and to reinforce the spirit of constructive co-operation both in the interest of the national economy and of service to the individual fuel user.

A Well-Balanced Report

WE have examined the report mentioned above, and should like to take the opportunity of congratulating the gas industry on the production of a well-balanced and well-considered review of the present and future position. The gas industry occupies a peculiar situation in that it serves both the large industrial and the small individual consumer, and its problems as universal provider of fuel require most careful consideration. The report quite clearly shows that such consideration has been given to every aspect of the case. What we particularly like about the report is its refusal to go in for uniformity for its own sake; co-ordination is never confused with regimentation. When the question of geographical integration is in hand, full cognisance is taken of the fact that different regions demand different treatment; whereas, when it comes to func-

tional integration, the advantages of having a central advisory body (the proposed Fuel Advisory Council), for bringing policy, practice, and organisation into line, are fully realised. Industrial chemists will be specially interested in the section dealing with Research and Technical Development, including the proposal to create Area Technical Development Centres. Any scheme that will lead to further investigation of gas by-products cannot fail to concern the Chemical Industry; and we propose to deal with this subject at greater length.

Chemicals and the Soil

THE lovers of humus and the spreaders of dung are evidently reaching the public ear with their high-powered propaganda aimed against the use of artificial manures. Their arguments, even when they are not entirely pseudo-scientific, are never more than half-scientific. One need hardly add that these arguments do not receive the support of the majority of scientists, and it is a false step for the propagandists to suggest that they do. But though these humic ideas do not seem to produce farm crops of notable superiority when they are applied, they are producing a rich crop of supporters and popular expositors. In the House of Lords last week Lord Teviot argued that the use of artificials had led to soil erosion. But that is nothing more than a half truth. Soil erosion—the rape of the earth, as it is so arrestingly called—has arisen, to a large extent, from that nomadic, get-rich-quick style of farming which has converted great tracts of the United States, for instance, into a gigantic dust bowl. The result was achieved largely through a complete disregard of the first principles of good husbandry. These farmers exhausted the natural fertility of the virgin soil, and, after ignoring the precept that what is taken out of the soil must be put back, they moved on to new lands which they wasted as quickly as those which they left behind them. Bad farming, wherever it exists, must be eliminated by education. It is not to be excused by attributing the ruin of the soil to the unproved toxic effect of artificials. There is something savouring of the naturopath at the back of this anti-artificials propaganda. One takes it for granted that Lord Teviot and his associates reject synthetic drugs when they are ill, preferring herbs to M & B 693.

I.C.I. Artists

OUTSTANDING among the many prestige advertisements which have appeared in our war-time newspapers and periodicals have been those of I.C.I., Ltd. The two series—"Aspects of an Industry" and "Services of an Industry"—have not merely performed their normal commercial function, but have also done the whole chemical profession a service by helping to dispel public ignorance about the contributions that chemistry is making to modern civilisation. The "copy" has been excellent in every instance, being in the form of articles that would be a credit to any popular science journal. As Mr. J. G. Crowther suggested at the recent British Association conference, their style might well be copied by the publicity staffs of some of our less progressive Government departments. The illustration of these series gave I.C.I. the opportunity to patronise the arts, and the company is to be congratulated on having commissioned so many well-known artists to paint original pictures that must undoubtedly have attracted many people into reading the articles printed underneath. We are interested to know that eight of these paintings are now on view at the annual exhibition of the Society of Scottish Artists in Edinburgh. Anna Zinkeisen is exhibiting the originals of "Our Daily Bread" and "All the Colours of the Rainbow," Tunnicliffe also has two pictures on show, while other I.C.I. artists represented there are Edward Wadsworth, John Armstrong, Doris Zinkeisen, and A. R. Thomson.

LETTER TO THE EDITOR

Penicillin and Arsenic

SIR,—It does not appear to be known generally that certain bacteriological cultures will not grow satisfactorily (if at all) when glass containing arsenic is used. I believe that some of the difficulties experienced by chemists working with penicillin may be due to this cause.

I shall be glad to make suggestions to anyone who suspects trouble of this kind.—Yours faithfully,

NORMAN SHELDON, A.R.C.S., F.I.C.

November 2, 1943.

Electrolytic Chlorine, III

Free-Diaphragm Cells

by D. D. HOWAT, B.Sc., Ph.D., F.I.C., A.M.I.Chem.E.

(*Continued from* THE CHEMICAL AGE, *October* 23, 1943, *page* 408)

SALIENT points of four representative types of free-diaphragm cell may now be noted briefly.

1. *The Hargreaves-Bird Cell.* This cell is worthy of note in that the alkali product is sodium carbonate, not caustic soda, the former (together with the chlorine) being utilised in the manufacture of paper pulp. Three plants using this type of cell are operated by the West Virginia Pulp and Paper Company. The main body of the cell consists of an iron base lined with brick and concrete which may be impregnated with tar to prevent leakage. The cell is divided lengthwise into three vertical compartments by cement-asbestos diaphragms made on heavy copper gauze forming the cathodes. Brine enters at the bottom of the middle compartment, which contains graphite anodes and overflows through the outlet at the top. The chlorine, released from the anode, passes upward to the outlet pipe, while a certain quantity of solution carrying the sodium ions passes through the diaphragm to the cathode. The caustic alkali formed in the cathode compartment is transformed to carbonate by the introduction of carbon dioxide and steam, the latter assisting in maintaining the porosity of the diaphragm. The solution containing sodium carbonate and salt is withdrawn from the cathode compartment as fast as it percolates through the diaphragm. (Fig. 9.)

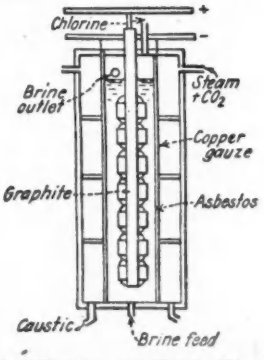


Fig. 9.—Hargreaves-Bird Diaphragm Cell for production of sodium carbonate and chlorine. Note the introduction of carbon dioxide and steam (MANTELL).

2. *The Krebs Diaphragm Cell.* As shown in Fig. 10, the cell, of the vertical type with unsubmerged cathodes, contains one or more cathodic elements. The cells contain two graphite anodes and a cathode constructed from a perforated sheet-iron box in the shape of a W and lined with an asbestos paper and tissue diaphragm. The feature of the cell is the easy replacement of the diaphragm. The whole cathode assembly is welded to a T-iron frame situated near the top of the cell, the anodes, anode chamber, and cathode being removable at one operation. A new cathode unit may be introduced with minimum loss of operating time.

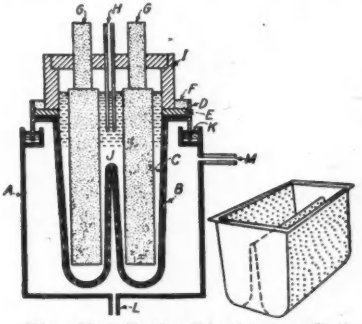


Fig. 10.—Krebs Diaphragm Cell (W-Type).

A, Cathode tank; *B*, Perforated cathode; *C*, Asbestos paper diaphragm; *D*, T-iron frame; *E*, *F*, Special joints; *G*, Artificial graphite anodes; *H*, Brine feed; *I*, Refractory anode box; *J*, *K*, Hydraulic joints; *L*, Caustic outlet; *M*, Hydrogen outlet.

3. *The Wheeler Cell* (Fig. 11.) The outer casing of the cell is of sheet steel, which terminates in flanges on the concrete base of the cell. The cell cover and the weight of the anodes are supported by a cylindrical concrete pedestal. The cell is cylindrical in cross-section, the cathode being formed by twisting a

sheet of woven steel wire into a cylinder open at both ends. The diaphragm is of asbestos paper. Arranged in a circle just inside the cathode are the graphite

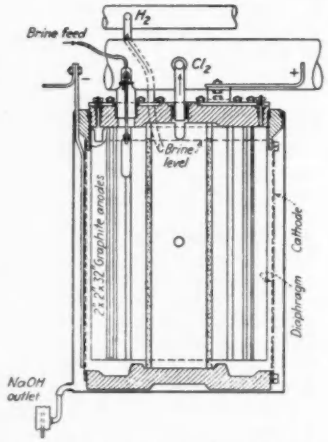


Fig. 11.—Wheeler Diaphragm Cell (MANTELL).

anode rods, 2 in. by 2 in. by 32 in. long, each rod being screwed into a terminal fixed in the concrete cell cover. The cover base and pedestal of the cell are made of concrete, impregnated with Trinidad asphalt. Long life of the anodes is claimed, with an anode consumption of 10 lb. per ton of caustic produced.

4. *Electrolytic Cell patented by I. G. Farbenindustrie.* Some interesting modifications of a free-diaphragm cylindrical cell are embodied in a recent design patented by this German firm. One disadvantage of many types of cylindrical cell is the existence of only a single cylindrical cathode and diaphragm, the anodes being arranged in a circle within the cathode. The total cathode area in any given cell is therefore strictly limited, the total load carried in any of the designs noted varying from 900 to 1600 amps. The new design incorporates cathodes in the form of four concentric cylinders. Fig. 12 shows the general outline of the cell and the compact close-packed arrangement of cathodes and anodes. Within the cell the anodes are set in two concentric circles of graphite rods. The cathodes, made from perforated sheet-iron faced with an asbestos diaphragm, are arranged in such a way that each pair of cathodes encloses a ring of anodes, the diaphragm being interposed between the anode and cathode. Copper rings, secured to the tops of the two rows of anodes, are coupled to the positive pole of the supply. The cathodes are connected to the electrical supply by two copper bars riveted on to the outermost cathode at two opposite points. The four cathodes are interconnected at the base by a four-armed spider. Inlets for brine, the outlet pipe for chlorine, and the drain cock for alkali are provided as shown. With a diameter of 120 cm. (47 in.) the cell operates with a potential drop of 3.3 volts at a rating of 3500 amps. The cathode solution carries 80/100 gm. of caustic per litre, the power consumption being 246 kWh per 100 kg. of caustic and the current efficiency 93 per cent. The chlorine gas is 98.5 per cent. pure.

Although not installed to any extent

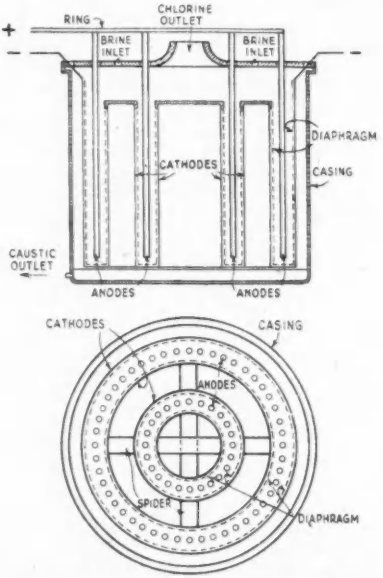


Fig. 12.—I.G. type Free-Diaphragm Cell (B.P. 492,688). Compare the arrangement and number of electrodes with Fig. 11.

in the U.S.A. or this country, mention may be made of the horizontal-diaphragm type of cell. The longer life of the horizontal cells, believed to be due to the smaller surface exposed to the attack of the hypochlorite anode solutions, may be set off against the smaller space area occupied and the easy access of the vertical cells, while the horizontal cells yield a caustic solution of 3N to 3.5N in contrast with the 2N to 2.5N solutions produced by the vertical cells.

The horizontal - diaphragm cell, Siemens-Billiter, formerly extensively employed, is affected by current interruptions frequently causing damage to the diaphragms. This disadvantage has apparently been largely overcome in the new design of the Siemens-Pestalozza cell, shown in Fig. 13. The anode arrangement of this cell is very similar to that of the older type, but the horizontal cathodes are formed of iron rods contained in asbestos hose constituting the diaphragm. The hydrogen is led off through the hose, escaping by a side chamber in the cell, while the caustic is removed continuously, partly through

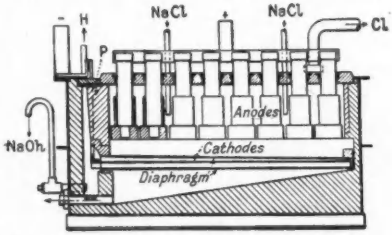


Fig. 13.—Siemens-Pestalozza Diaphragm Cell (FISCHER).

the hose and partly by gravity flow from the bottom of the tank. The claim is made that the pores of the asbestos hose do not become clogged so permitting the use of impure sodium chloride solutions.

Filter-press Diaphragm Cells

The plate and frame filter-press, used extensively in chemical engineering, has been modified and adapted to serve as an electrolytic cell, asbestos diaphragms taking the place of filter cloths. This type of cell has been widely employed in the electrolytic production of hydrogen and oxygen from 20/30 per cent. hydroxide solutions, but does not appear to have found any wide application in the production of electrolytic chlorine. Mention may be made of the outstanding features of two filter-press cells recently patented by the Dow Chemical Company for the production of electrolytic chlorine.

The arrangement of the anode and

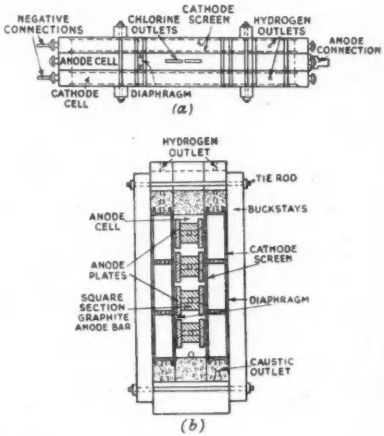
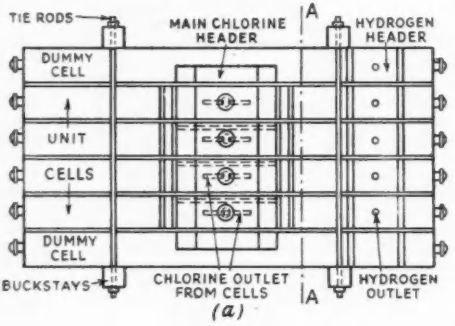


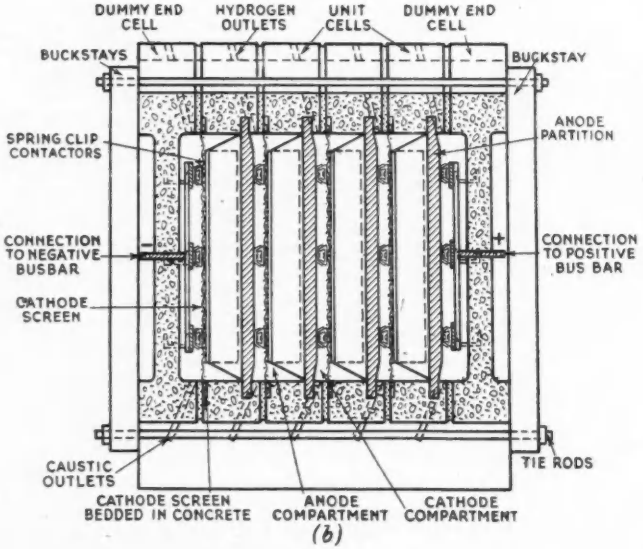
Fig. 14.—Dow Chemical Company's Multi-Polar Filter-Press Type of Diaphragm Cell. (a) Plan view of cell assembly, showing two cathode and one anode cell units. (b) Vertical cross-section of cell assembly.

cathode cell units is indicated in Fig. 14. (U.S.P. 2,161,166.) The anode units are composed of an outer frame of non-conducting material, usually concrete, within which are housed three or more superimposed anode carrier bars of graphitised carbon, square in section, the bars projecting through one side of the frame for connection to the power supply. Bolted to each side of the bars are flat graphitised carbon anode blocks almost covering the side area of the frame. In the top of each anode cell is a port through which the salt solution enters and by which the chlorine generated in the cell escapes. These parts open into a common header which extends across the width of the cell assembly. The cathode units comprise an outer concrete frame joining squarely and smoothly with that of the anode unit and enclosing a steel framework, to each lateral face of which is welded

the perforated steel sheet or wire screen cathode. The diaphragm of asbestos paper is fixed to the outer face of the cathode units. A lug from the steel frame projects through the concrete and is coupled to the power supply. The cathode units drain to a common outlet for the discharge of the caustic soda solution. The hydrogen generated at the cathode escapes through passages in the top into a common header.

One of the most recent designs of filter press cell brought out by the Dow Chemical Company (U.S.P. 2,282,058) includes a number of interesting features. The assembly comprises a given number of unit cells, each divided into an anodic chamber and a cathode chamber, a dummy cell completing the assembly at each end. Each unit cell is enclosed in a frame, usually composed of concrete. The graphite anode partition stretching





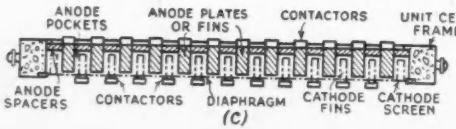


Fig. 15.—Dow Chemical Company's Bi-Polar Filter-Press Type of Diaphragm Electrolytic Cell (U.S.P. 2,282,058).

(a) Plan view of cell assembly, showing four unit cells and two dummy end cells with cell cover in place.

(b) Longitudinal section of cell taken along the line A . . . A of plan view shown above.

(c) Sectional view of a unit cell, showing alternation of anode and cathode fins, anode pockets, etc.

across the width of the unit cell is embedded in the concrete at each end, forming the sole partition between one unit cell and the next. To the flat surface of the partition are bolted spring clips which form the electrical connection between adjacent cell units. These clips, fitting together by frictional contact with other male-type pattern clips bolted to the back of the cathode screen, permit good electrical contact and are sufficiently flexible to accommodate slight variations in the alignment of the adjacent frames. The arrangement of the clips is shown in Fig. 15 (b). The graphite anode partition is really built up as a segmented structure composed of alternate vertical spacers and vertical boards or fins, so arranged that the back surface to which the clips are bolted is flat, while the reverse surface is formed of a series of projecting fins or ribs at right angles to the partition, providing a series of anode pockets. The anode plates are chamfered top and bottom to allow easy circulation of solution.

The cathode partition consists essentially of a coarse steel wire screen to which are bolted wire screen fins or ribs spaced so as to fit into the pockets between the ribs on the anode partition. The cathode screen is secured at its outer edges to a metal framework which fits into a recess in the concrete sides and is held in position by bolts and nuts. To allow easy circulation of solution in the cathode compartment, narrow slits are cut in the cathode screen along the lines corresponding with the space inside the fins or ribs. In the assembled cell all portions of the cathode screen and fins exposed to the anode chamber are covered by a permeable diaphragm—one or two layers of asbestos paper. Fig. 15 (c), a cross section through a unit cell, shows the arrangement of the anodes and cathodes with the alternating fins or ribs forming the pockets.

Brine Feeding System

Brine is fed to the anode chamber of the cell by upright passages entering into a common header built across the cell tops. The chlorine evolved at the anodes is withdrawn through this same header. The solution percolates through the diaphragm into the cathode chamber, where hydrogen is liberated and sodium hydroxide formed. The hydrogen escapes from the top of the chamber through small vertical passages which enter a small common header. The caustic soda solution trickles down the walls of the cathode chamber and flows through the cathode drain to an external collecting trough. Electrical power for the entire electrolytic cell enters and leaves by means of the terminals indicated in Fig. 15 (b), the current passing from each anode to the succeeding cathode by the spring clips described.

The outstanding features of the filter-press type cells are extreme compactness, small floor space, close approximation of the electrodes, and ease of assembly. The bipolar type described above offers the additional advantage of simplicity of external electrical connections. Very great care is necessary to ensure tight joints between the adjacent cell units, special jointing mixtures of concrete and asphalt being employed.

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New British Standard

Bronze Oil-Retaining Bearings

THE British Standards Institution has recently issued a War Emergency British Standard for the dimensions of bronze oil-retaining bearings (B.S. 1131). This standard has been prepared in collaboration with the Ministry of Supply and the three manufacturers of this type of bearing. Its primary aim is to bring about a modification in the variety of types and sizes of bearings and so to facilitate more rapid and economical production by concentrating the supply and demand on a simplified range of standard sizes. The present standard relates to cylindrical-type bearings of nominal bores from 3/16 in. to 2½ in. Various alternative standard lengths are established in the schedule and the appropriate limits are given for the bore of the housing into which the bearing is to be assembled. Each size and length of standard bearing has been given a specific reference number for convenience when ordering. Further specifications are to be issued later for flanged bearings and thrust washers.

FUEL ECONOMY IN THE CHEMICAL INDUSTRY

Fuel Efficiency Lectures

II.—Heat Exchange, including the Use of Effluents

by H. F. GOODMAN

THE subject of heat exchange is so large, involving permutations and combinations of the interchange between solids, liquids, gases, condensing vapours and evaporation, by radiation, conduction, and convection, that it would be impossible even to scratch the surface in an introduction of this length. It is therefore proposed to confine the subject mainly to one aspect, that of heat exchange between liquids. Although greater economies are normally effected by the re-usage of latent heat, the fact that no vapour hovers over a plant does not necessarily mean that all has been done that can be done to save fuel. Very substantial savings can be made by reclaiming heat from hot liquids and effluents.

Effective Heat Regeneration

It would be as well at this stage to give some examples where heat regeneration has been applied to good effect. In many processes a liquid is heated or cooled and, after treatment, is brought back to roughly its original temperature. If full heat reclamation could be applied, then obviously no extra heat (or cold) would have to be supplied. Such an ideal can never be attained, but the principle of regenerative heat exchange can economically be applied in many cases to save the greater part of the fuel otherwise necessary to carry out the heat treatment. One form of heat treatment consists in heating a liquid to a temperature of about 72° C. and, almost immediately afterwards, cooling down to 5° C. In many cases the temperature of the unheated liquid is also at about 5° C. so that, without regenerative effect, 1200 lb. of steam produced by the combustion of 1¼ cwt. of coal would be required to heat each 1000 gallons. By passing the hot liquid in counter-current flow against the cold untreated liquid in a regenerative heat exchanger, the untreated liquid can be heated through most of its range without the expenditure of fuel. In practice it is often found economic to use 80 per cent. or more of the available heat in this manner, thus reducing the steam consumption to one-fifth.

High percentages of recuperation such as this often effect a further saving, that of refrigeration. During the hot months the processed liquid can be cooled regeneratively to a temperature lower than could be reached by water cooling, and, as one degree of refrigeration costs in fuel many times that of a degree of heating, the economy is very real. Milk is a liquid treated in this way, and as 3,000,000 gallons of milk are consumed each day and 65-70 per cent. is pasteurised, this is rather a good example of what can be (and to a great extent is) saved in one industry. "Heat" treatment is sometimes carried out the other way—by refrigeration, usually for the purpose of clarification. Examples of this are the artificial aging of some of the cheaper wines, and the dewaxing of lubricating oils. Recuperative heat exchange is difficult in the latter process because of the high viscosity and poor conductivity of the oil.

While still on the subject of beverages it is worth mentioning how fuel is often saved in breweries. Here malted grain is steeped in hot water, the extract or wort is boiled and then cooled to a low temperature for fermentation. Many breweries have their wort coolers so arranged that the first stage of cooling is done by the water to be used for the next brewing, thus saving much of the heat required to raise the temperature of this water. The water used for the second cooling stage is often used for washing purposes.

Distillery Practice

Distilleries must, by their very nature, use large quantities of steam. For the production of commercial alcohol in this country a molasses wash is fermented to an alcohol content of about 7 per cent. The tepid wash is fed to the stripping section of a distillation column, live steam is admitted to the base of the column and the alcohol vapour, with a small proportion of water vapour, issuing from the top of the column is condensed. The hot effluent, consisting of the remainder of the water plus the condensate of the steam admitted, passes away from the bottom of the column. Not many years ago the alcohol vapour was condensed by water and the effluent at a temperature above atmospheric boiling point went down the drain. To-day, most manufacturers have increased in wisdom and have cut their steam consumption by a third. Common practice is now to pass the wash after fermentation through the liquid passages of the alcohol condenser, partly condensing the alcohol and preheating the wash. The partly heated wash is then passed through a counter-current heat exchanger with the hot spent wash on the other side, and is raised to boiling point before admission to the still.

A word of warning may be mentioned here: superficial examination sometimes points to a possible saving in heat, but closer analysis reveals that this heat, if reclaimed

at one stage, may have to be supplied at a later stage in the process. For example, in France alcohol is produced from beet sugar. The effluent from the primary distilling column contains salts valuable for their manurial properties and is accordingly evaporated. Usually in these circumstances there is no point in preheating the feed by the effluent, as the heat taken from the effluent would have to be made up in the evaporators.

Acetone Manufacture

Somewhat similar uses are found in other chemical industries. One example is in factories where acetone is manufactured or recovered from absorption systems. In some of these cases the matter of degradation of energy is of very much moment. The average strength of the acetone/water mixture as it leaves the absorption system is only 2 per cent. of acetone. Hence 100 gallons of this mixture have to be heated to boiling point, 200° F. (93° C.), to distil off 2 gallons of acetone. As the latent heat of acetone is only about a quarter of that of water it is obvious that although little heat may be available from the condensers —and that at low potential, 132° F. (56° C.) —there will be much heat available from the effluent at the bottom of the still at about 220° F. (106° C.). Hence, heat exchangers fitted to the bottom of the stripping section of acetone stills are a very paying proposition.

Benzol Extraction

One further example will be quoted, the extraction of benzol from coal gas. Petroleum gas oil or creosote is passed at a comparatively low temperature through scrubbing towers where it absorbs benzol from the gas; it must then be heated in a stripping still for the extraction of the benzol. The wash oil is cooled and returns once more in closed circuit to the scrubbers for further absorption. When the regenerative cycle is employed the benzolised oil from the scrubbers is first preheated by the benzol vapour extracted in the still and is further preheated before the final steam heating by the hot debenzolised oil leaving the still. The debenzolised oil in the same way is partially cooled by regeneration before being water-cooled and pumped back to the scrubbers. This process gives the engineer some headaches: oil at all times is a poor conductor of heat and the heat exchangers must be large; moreover the wash oils used have a way of thickening with use. Some also throw out a flocculent deposit which tends to choke heat-exchangers and pipelines, and as the oils are of a penetrative nature there is the bugbear of leaking joints.

In all the extraction and distillation processes mentioned the proportion of carrier liquid, whether it is circulated or discarded, is large compared with that of the desired product. It is obvious that here we have considerable scope for reclaiming by interchange much of the heat that would otherwise be lost.

Types of Exchanger

There are many forms of heat exchanger, from the simple cast-iron and steel shell-and-tube type to the more elaborate machine, made of incorrodible materials, in which all surfaces can be opened up for cleaning. The two media between which the exchange of heat is to take place are always separated by a conducting surface, almost invariably of metal. Desirable qualities of the material used for this surface are cheapness, ease of fabrication, strength, high conductivity, and resistance to erosion and corrosion. Cast iron and steel are largely used where corrosion is of little account. Copper and gunmetal have a wide field in the chemical industry, being comparatively cheap, of high conductivity, easily fabricated, and resistant to many products. Aluminium has its particular scope when certain acids are to be dealt with. Where highly corrosive liquids are encountered, or when the slightest contamination of the product is fatal, the nickel alloys, and particularly stainless steel, are being used more and more. These metals are expensive and, unfortunately, of lower conductivity; careful design to give high rates of heat transfer becomes more necessary from the economic angle, although usually the heat resistance of a metal wall is very low compared with that of the liquid films. In a few cases metal heat-exchanging walls are coated with a non-metallic lining, such as one of the plastics or enamels, but it must be remembered that the thermal conductivity of all such materials is of the order of one five-hundredth of that of copper, so that the coatings must be extremely thin or the abnormally large surfaces required rule their use out of court.

Physical Factors

Factors affecting the rate of heat transfer from the liquids themselves to the dividing wall are the physical properties of the liquids, density, conductivity, specific heat and viscosity, the velocity and kind of flow, whether turbulent or laminar, the size and shape of the liquid passages and, of course, the temperature difference between the two liquids. Most liquids, fortunately, are of sufficiently low viscosity for fully turbulent flow at reasonable velocities to be maintained without excessive power consumption. By now the laws pertaining to heat exchange, at any rate for turbulent flow, are sufficiently well established to allow the engineer to calculate with reasonable accuracy the surface he will require, but he must balance carefully the various economic factors—how much of this waste heat can he afford to use; what will be the cost of his heat

exchangers and extra pumping costs—offsetting these against fuel economy and, what is often a greater factor to him if not to the nation, at the present time, the reduction in size and maintenance of the boilers or refrigerating plant.

That it is usually a highly economic proposition to instal heat exchangers can be judged from the order of this example. A simple copper shell-and-tube heat exchanger of reasonable size costs about 10s. per sq. ft. Suppose we have an effluent at a mean temperature 33° F. (18° C.) above that of a liquid being heated and we can calculate on a rate of heat transfer of 300 B.Th.U./hr./sq. ft./° F. To save each million B.Th.U. per hour would require 100 sq. ft. of surface at a capital cost of £50. 1,000,000 B.Th.U. require about 2s. worth of fuel at a very nominal figure, so that, on an 8-hour day, the heat exchanger will have paid for itself in 62 days on fuel alone. These figures, of course, will vary over a wide range, but this little example gives an idea of the order of things.

I will conclude with a case of abuse that I myself witnessed some years ago. A large plant was installed, one of the largest of its type in this country, if not in the world, for the heat treatment of a liquid. This liquid is heated from little above freezing point to a fairly high temperature, and is cooled down again to its original temperature. The regenerative section of the heat exchangers gave over 80 per cent. recuperation. During the winter months, when water is cold, some advantage is gained by water-cooling between regenerative cooling and refrigeration, but in the spring conditions change so that the liquid can be cooled down as far by regeneration only. I called there one hot day in August and found that the liquid was entering the brine-cooling section some 10° to 15° higher than it should have done. I then discovered that the water-cooling section was still in operation and instead of functioning as a cooler the water was heating the product through those missing degrees. Not only was the refrigeration plant being wastefully overloaded at the worst possible time of the year, but many thousands of gallons of expensive town's water were going down the drain.

Technical Discussion

Q. What type of heat exchanger is recommended for benzol plants? Experience with the type in which the oil on one side passes through a tube and on the other through an annular space shows that the first can fairly easily be cleared of sludge but the other is very difficult.

A. No satisfactory solution has yet been found. Plants have to be closed down periodically for cleaning and even then cleaning is a difficulty. The only sound method seems to be the completely openable type, such as the plate type, but that means joints. Work is in progress to solve this problem.

Q. What extra capacity is recommended when calculating condensers, bearing in mind that they are often overloaded?

A. Condensers are usually of simple construction and it nearly always pays to be liberal. Some heat exchangers can be calculated with remarkable accuracy, but where unknown factors come in, such as scaling of the surfaces, and overloading, it is always advisable to be generous and, maybe, to allow 50 or 100 per cent. extra surface above the calculated figure.

Q. What would be the comparative efficiencies of heating by steam and hot water at the same pressure? What water velocity would be required to give the same effect as steam?

A. Almost invariably the heat-transfer coefficient from condensing steam will be higher than from water; with reasonably clean tubes it would be in the neighbourhood of 2000-3000 B.Th.U./sq. ft./hr./°F. and a very high water speed would be necessary to attain this. Normal to high water velocities of the order of 7-15 ft./sec. would give about half these values but all the factors involved should be correlated. Often the heat-transfer rate on the other side is much lower, so that on the overall transfer, which brings in the sum of the resistances, there might be very little difference between the use of steam or hot water.

Q. Mention was made of the utilisation of the heat in effluents from a continuous distillation plant. Can this be applied in batch plants?

A. Yes, provided that storage capacity can be arranged to hold the liquid heated by the effluent from a batch. The brewing example given is an instance of this; the water heated by the hot wort is stored in hot liquor tanks until the next brew.

Q. Aluminium tubes are sometimes used in heat exchangers and condensers. Is it possible to get dropwise condensation and consequently higher heat transfer with these?

A. Aluminium in general has not a good surface for dropwise condensation. It might be possible to produce it for a time by the introduction of vegetable oils into the steam. My own opinion is that dropwise condensation is usually of academic interest only. The heat-transfer coefficient is nearly always so much lower on the other side of the tubes than that of steam condensing filmwise that little advantage would be gained. It is again a matter of working out the overall resistance and the gain would probably be very small in most processes.

Q. Heat transfer is slow in tubular condensers where the cooling medium is outside the tube because of the stagnant layer which exists close to the tubes. Is there any means

(*Continued on p. 477*)

Metallurgical Section

Published the first Saturday in the month

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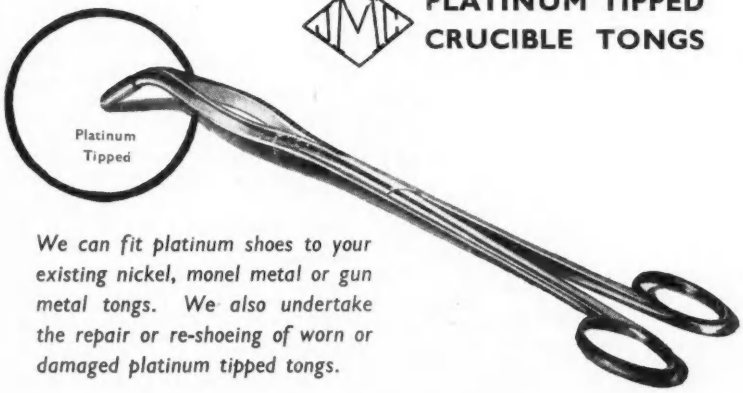

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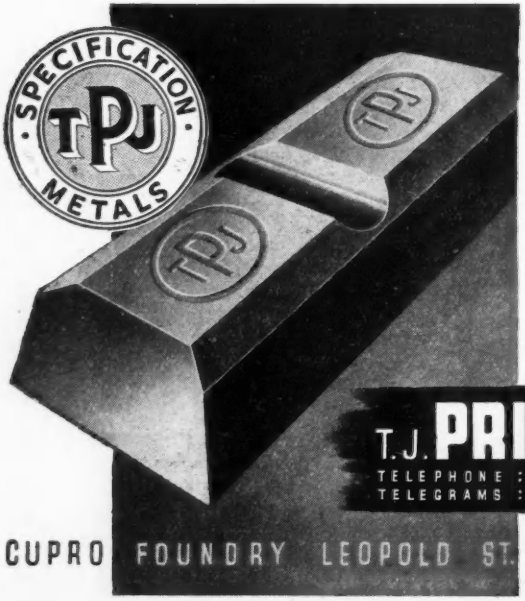

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Metallurgical Section

November 6, 1943

Sodium Cyanide for Carburising

Case-Hardening Steel

by L. G. WHYBROW PALETHORPE, F.I.C.

THE carburisation of iron is one of the oldest of the heat-treatment processes. In fact, it is believed that some of the sword blades and tools of earlier times owed their efficiency to this art. More recently, it was by carburising wrought-iron bars that steel was first produced, namely, by the Cementation process. Nowadays, carburising practice is devoted almost entirely to the production of surface-hardened steels. The case-hardening process by which this is effected is well known as a reliable method of conferring on mild steel the hard, wear-resisting properties of tool steel without impairing its mechanical quality.

Carbon case-hardening practice is divided into two distinct stages: (1) the carburising of the outer layers of the steel; and (2) the hardening of the case produced. The former, a complex chemical reaction, has developed in recent years into a highly scientific operation, capable of being brought about by various media. It is conducted in the austenitic phase of steel at temperatures ranging from 850° to 950°C. according to requirements. The component to be treated is heated in contact with the carburising medium until the required depth of case is obtained. The second stage consists of correcting the grain size of the steel and hardening the case by quenching.

Carburising Media

The method of carburising most familiar to the trade is the "box" process, colloquially called "pack hardening." It consists of packing the parts in carbonaceous material (usually of a proprietary nature) contained in a box and heating out of contact with air at a temperature a little above the critical point, Ac3, of steel. Considered from the production viewpoint, box carburising has the following disadvantages. It is difficult to ensure uniform heating, the lack of which causes variable penetration and excessive distortion. Both the time taken to reach the carburising temperature and the rate of penetration are hard to determine accurately. It is difficult to ensure that each component is adequately surrounded with compound especially when handling small work. There is always a tendency towards cementite formation in the case, which leads to brittleness and the formation of exfoliation cracks.

To overcome these disadvantages, several alternative methods have been tried, among which paste, gas, and liquid carburisers have featured. The most popular of these, and the one which has developed most rapidly during the last few years, is the liquid carburising bath using sodium cyanide as the active medium. Liquid baths, in which components are immersed for the requisite time, allow of uniform heating and penetration. They are superior in temperature control and rapid in conferring the necessary depth of case. On account of the nature of the process there is no tendency to cementite formation in the case.

The Cyanide Process

It has long been known that cyanides are capable of transmitting carbon to red-hot iron and steel. Indeed, superficial hardening of small work is still carried out by the older type of craftsman, using sodium cyanide or ferrocyanide in powder form. The work is brought up to a good red heat and dipped in the powder, reheated for a few minutes and quenched in water. The modern process, which is really a scientific application of the old idea, is as follows. A bath of molten salt consisting of 50 per cent. sodium cyanide and 50 per cent. sodium carbonate is operated at a temperature of 850° to 950°C. according to requirements. Carburisation is effected by immersing the work in the liquid for a predetermined time depending upon the depth of case required. The case is then hardened according to standard procedure.

The furnace used to heat the salt is of simple design (Fig. 1) consisting usually of a calorised pot surrounded by refractory masonry encased in steel plates. The heat is supplied by forced air/gas burners set tangentially to the pot. In the best plant is incorporated a preheater coupled to the main furnace and heated by exhaust gases. A canopy and duct fitted with an extraction fan to take away the fumes must be placed over the furnace in order to comply with the Factory Act regulations.

As previously indicated, the cyanide car-

burisation of steel is a very complex surface reaction, and exactly what takes place is not known. What is known, however, is that oxygen takes part in the reaction and that both nitrogen and carbon are present in the case produced. Several suggestions have been put forward to indicate the mechanism of the reaction. Those explaining the liberation of the active carburising agents are given here.

According to Schlumpf[1], sodium cyanide is oxidised to cyanate, which decomposes to give the active agents carbon monoxide and nitrogen: $2NaCN + O_2 \rightarrow 2NaCNO$: $4NaCNO \rightarrow 2NaCN + Na_2CO_3 + CO + 2N$. According to Barsky[2], sodium cyanide may react with oxygen in two ways, (a) to form active carbon monoxide and nitrogen: $2NaCN + 2O_2 \rightarrow Na_2CO_3 + CO + 2N$; or (b) to form cyanate which, in turn, decomposes, giving active carbon only: $2NaCN + O_2 \rightarrow 2NaCNO$: $3NaCNO \rightarrow NaCN + Na_2CO_3 + C$.

Which of these is correct remains a matter for conjecture. It is certain, however, that the active agents are carbon, carbon monoxide, and nitrogen. These are liberated in "nascent" form and react on the surface of the steel to form carbide and nitride of iron or solid solutions of carbon and nitrogen in gamma-iron, according to which theory of iron-carbon metallurgy is accepted. As the reaction progresses, so does the depth of case.

Composition of Cyanide Case

As stated previously, cases produced through the medium of cyanide carburisation contain both carbon and nitrogen. The optimum conditions for the production of a high-nitrogen case are a strong salt bath operated at a relatively low temperature, while a high-carbon case, almost free from nitrogen, is best produced from a bath of moderate strength operated at high temperature. The normal carburising conditions fall between the two extremes. Therefore, the ratio nitrogen/carbon will be inversely proportional to the working temperature. Generally speaking, it is found that cases produced at the normal operating temperatures (850° to 950°C.) contain 0.7 to 0.8 per cent. carbon and 0.4 to 0.5 per cent. nitrogen, being, therefore, just hypo-eutectoidal with respect to carbon. This eliminates proneness to exfoliation cracks to which some box-carburised steels are subject.

As with box carburising, the rate of penetration is affected by temperature. Carburisation is always carried out in the gamma phase, *i.e.*, above Ac3, and the higher the temperature rises above this critical point, the more rapid is the penetration. It is not recommended, however, to operate above 950°C. on account of the tendency to grain growth. Fig. 2 shows penetration rates obtained under normal working conditions. It is usually accepted that the depth of case is a measure of the total penetration from the surface inwards to the point at which the carbon content has fallen to that originally in the steel. The nitrogen content falls too, but much more rapidly. The hardness tends to remain at a constant figure for about half of the case depth and then falls away almost linearly with that of the core. Fig. 3 illustrates the relationship between the carbon and nitrogen contents and the hardness of the quenched case.

With good bath practice, therefore, relatively deep penetrations can be obtained and surface hardnesses compare favourably with those obtained by the box process. However, the maximum hardness of a box case persists deeper (to about 60 per cent. of the total case instead of about 50 per cent. with a cyanide case).

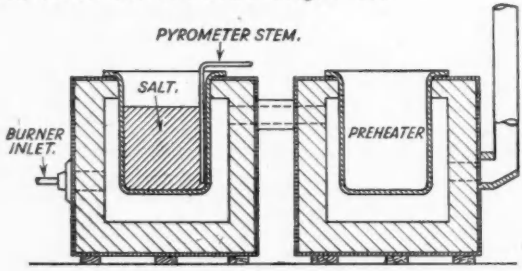

Fig. 1.—Diagrammatic arrangement of salt bath furnace.

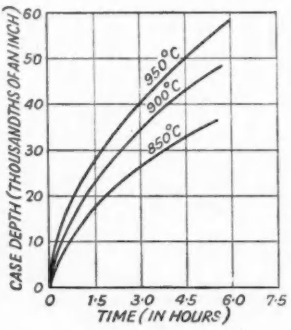

Fig. 2.—Relation between penetration and time of immersion in salt at normal operating temperatures (bath strength 50% NaCN).

Further, the cyanide case is more brittle than the box case on account of the nitrogen content.

Since its inception, the cyanide process has been modified and improved, as have many other processes before it, in order to meet special needs. With the original 50 per cent. sodium cyanide baths there are the disadvantages mentioned above, and in addition, a possible poison hazard. To counteract these, the tendency has been to reduce the cyanide content to between 12 and 20 per cent. and to add catalysts to maintain the rate of penetration. Operating temperatures remain the same. The catalytic agents which are most frequently used are calcium cyanide and cyanamide, alkali and alkaline earth chlorides, and sometimes polymerised hydrocyanic acid. The mechanism of carburisation in these active baths is more complex than in straight cyanide baths. Nevertheless, according to Schlumpf[1], the active agents carbon monoxide and nitrogen are liberated as before.

With regard to composition, the cases from these new baths contain a little more

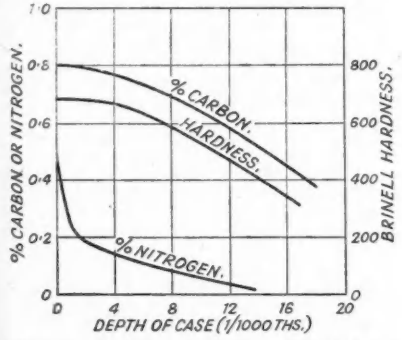

Fig. 3.—Relation between carbon and nitrogen contents and Brinell hardness of a quenched cyanided steel.

carbon (they are almost eutectoidal in regard to carbon content) and much less nitrogen. Actual figures are 0.8 to 0.9 per cent. carbon and 0.2 to 0.3 per cent. nitrogen. Penetration is more rapid in activated baths, particularly after the first 0.010 in. For example, cases from calcium cyanide activated baths grow about 25 to 50 per cent. more rapidly than from plain cyanide baths (Fig. 4). Actually, they approach in nature cases obtained by box carburising, being much less brittle owing to the fall in nitrogen content.

Nowadays, 50 per cent. cyanide baths are only used for shallow cases. There are on the market proprietary activated carburising salts which can be used with advantage for the deeper cases.

Refining and hardening operations are similar whichever carburiser has been used. For general work and with special fine-grained steels, the refining operation is

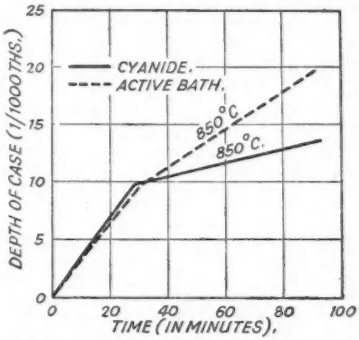

Fig. 4.—Graph indicating increase of penetration in calcium cyanide activated bath.

omitted and the work is hardened by quenching direct from the bath; in other instances the work is refined by quenching from the bath, followed by hardening, which is carried out by reheating and requenching from the prescribed temperature. The double quench, as it is called, corrects any grain growth which may have occurred during carburisation. With regard to quenching media only oil calls for comment. On account of the alkaline nature of the salt, vegetable and animal oils cannot be used. They would gradually become saponified. Mineral oils may be used with satisfaction.

Selective Carburisation

When work is to be hardened only in certain areas of its surface, carburisation must be selective. The use of clay, as in the box

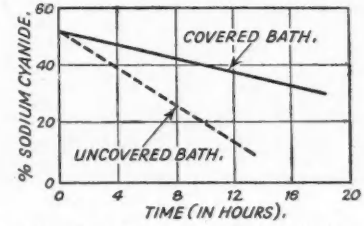

Fig. 5.—Comparison of relative losses of sodium cyanide in covered and uncovered baths.

process, is completely unsatisfactory. Were it to be employed, it would be attacked and dissolved by the salt and the product would contaminate the bath. There are, however,

two satisfactory ways of preventing carburisation on surfaces required to be left soft, *viz.* (1) by protection of those surfaces with sufficient stock to be machined off after carburisation but prior to quenching; or (2) by protection of those surfaces with copper plate. Either method involves extra process operations and expense which must, of course, be endured in the interest of producing a satisfactory finished article.

In the former method, about $\frac{1}{8}$ in. or more of stock, according to the depth of case, is left on the "required soft" areas, over and above the finished size. After carburisation, the work is cooled very slowly to prevent air-hardening. The excess stock is then machined away, leaving a low-carbon finished surface which will remain soft on quenching. In the latter method, the "required soft" areas are electroplated with copper to insulate their surfaces from the action of the carburising medium. This is done either by plating all over and removing the deposit where hardness is required or, alternatively, the "required hard" areas may be "stopped-off" with an acid-resisting lacquer to prevent deposition of copper on them. The factor which

[*By courtesy of I.C.I.* (*General Chemicals*), *Ltd., Heat Treatment Dept.*

Fig. 6.—Small type of salt bath furnace, with cyanide case.

decides the success or otherwise of this method is the nature of the deposit. It must be sufficiently thick to resist the solvent action of the molten salt and it must be *non-porous*. Table I shows the relation between the thickness of deposit and the case depth (which is proportional to the time of immersion).

TABLE I.

Depth of case (0.001")	Time of Immersion (minutes)	Thickness of Copper Deposit (0.001")
20	70	0.5
30	140	1.0
40	230	1.5
50	340	2.0
60	430	2.5
over 60	—	3.0

To produce a non-porous deposit of copper, great care in both cleaning and plating operations is essential. By degreasing and pickling, the steel must be thoroughly cleaned of grease and scale. Even with a scale-free surface, a short pickle in 20 per cent. hydrochloric acid is beneficial in increasing the "biting" power of the copper. The most satisfactory plating results are obtained from the cyanide type of bath operating at 40° to 50°C. and at current densities up to 40 amp./sq. ft.

In order to reproduce consistent results from cyanide baths, the strength of these in terms of sodium cyanide must be maintained at a constant figure. Although carburising power is not in linear relation to bath strength, any appreciable fall in the latter undoubtedly affects both penetration and the quality of the case. The rate of fall of cyanide content is proportional to the time at the operating temperature. The volume of work put through has a negligible effect. This follows from a study of the bath reactions given earlier, and so long as a good supply of air is available they continue linearly with time. However, decomposition can be arrested somewhat by restricting the air supply. As a rule graphite or plumbago is sprinkled on the surface of the melt to achieve this. Fig. 5 shows typical reductions in strength for covered and uncovered baths. To maintain the required strength the bath is analysed daily and the losses are replaced, usually in the form of commercially pure sodium cyanide.

The melt is sampled by immersing a clean dry steel rod in the bath and withdrawing it immediately. The crust left on it is ground up in a warm, dry mortar and 1 gm. is dissolved in 250 ml. warm water. A little lead carbonate (0.2 gm.) is added to remove sulphur. The filtered solution is titrated with standard silver nitrate until just opalescent; 1 ml. decinormal silver nitrate is equivalent to 0.98 per cent. sodium cyanide.

Precautions in Handling

No discussion of the cyanide process would be complete without a word about precautions in handling. Liquid salts containing cyanide can be dangerous in two ways. Explosions may be caused or poisoning may be incurred as a result of neglect.

If care is taken, however, accidents very seldom occur. Explosions are usually due to the immersion of wet work. If all work is preheated this danger is removed. An operator can be poisoned only by consuming cyanide. The fumes from the bath are *not* poisonous; they are mainly sodium carbonate. Provided that the salt is kept in a warm dry place and the hardener washes his hands before taking food (well away from the plant) he will come to no harm. Spent salt must be " killed " before disposal. It is both unlawful and dangerous to the community at large to act otherwise. It may be done in one of the following ways. Ferrous or hypochlorite solutions may be added to a solution of the waste salt in order to decompose it; or the solid waste may be exposed on a piece of well-protected waste ground until decomposition is complete. Then disposal may be carried out through the usual channels.

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GERMANIUM IN COAL ASH

Concerning Germanium in Coal Ash (*see* THE CHEMICAL AGE, October 30, p. 443), Dr. F. Frank writes: " I should like to mention that determinations regarding the content of germanium in coal-ash were made by Professor V. M. Goldschmidt between 1930 and 1933 (publication in *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen*, 1933; article entitled *Ueber die Anreicherung seltener Elemente in Steinkohlen*, by V. M. Goldschmidt and Cl. Peers). It has been ascertained that the highest content of germanium found in the ash was 1.1 per cent. and the average content 0.05 per cent. A series of British types of coal was placed at Professor Goldschmidt's disposal by Dr. F. Sinnatt, and germanium contents were determined in these; later the importance of germanium as a catalytic substance in the hydrogenation of coal was laid down.

GAS HOLES IN BRASS CASTINGS

The cause of gas holes in limited areas in brass castings has been traced to absorption of gas by the metal as it runs over the surface of a thin core, *The Iron Age* reports. In an experiment, a core had been partially saturated with wax from a wax core vent. This resulted in a decrease in the permeability of the core and an increase in the amount of gas formed by the core on heating. As a check on the effects of wax in the cores, a test was run. Standard sand permeability samples were made of the same sand mix. The top of one specimen was covered by a layer of wax in the core that caused the defect. A second sample was made up without wax. Both samples were baked for two hours at 216° C. The permeability of the sand was measured after baking, with the result that the core without wax had a higher permeability than the one with wax. On washing the wax-impregnated core with organic solvents, most of the wax was found to be present and unaltered. The conclusion drawn from this test was that the presence of wax in amounts of more than 4 to 7 per cent. of the volume of the core could be detrimental unless very open sands were used. The castings that gave rise to the investigation were made successfully by eliminating vents completely.

Factory Fires

Downward Trend Must Go Further

DESPITE encouraging progress on the Factory Fire Front there is no room for complacency or for holding up in our efforts to stem and scotch industrial fires resulting from our own carelessness. This was made clear by Sir Stafford Cripps, Minister of Aircraft Production, in a recent address at Reading.

" We looked to our fire-fighters to save our factories from the fire bombs of the Luftwaffe. I am glad to say that the R.A.F. have taken care of the Luftwaffe, but we cannot consider ourselves safe as long as the enemy is so near on the North Coast of the Continent. We shall have to be alert for incidents. But there is another menace — the menace of carelessness. Throughout the country day after day, fires are taking place which are the result of carelessness of persons working in our factories. Only the other day I was at an aircraft factory where a short time before, owing to an employee smoking a cigarette, a serious fire was caused and had it not been for the highly trained fire service that factory would have been lost together with fifty or sixty planes."

" There is one other factor that ought to make people more conscious of the fire danger. We have done our best through various sources to make people conscious of this danger of carelessness and I am glad to say that from the records that have come in it does appear that all we have been doing is having some real effect. The incidence of fires in factories is going down. But it has got to go much further before we can be satisfied with the results. I hope the enlightened public will realise the task and be more careful in their treatment of fires all over the country. We cannot afford this carelessness added to enemy action."

Siberian Metals

Russia's Metallurgical Reserves

ALTHOUGH exploration for minerals and development of metallurgical industries had been vigorously carried on by the Soviet Government before the war in vast territories of Eastern Russia and Siberia, this work has been accelerated and intensified by war conditions. It has been necessary to depend on these territories for a great part of the war material demanded by the Red armies; and how well these demands have been met is demonstrated by the recent brilliant successes of those armies against the Germans.

The mineral wealth of Siberia has long been known to be immense, if not virtually inexhaustible, but much of it is still unexplored. In *Pravda* it is now announced that geological expeditions during the war have enabled vital mineral needs to be met from the East to replace supplies hitherto available in Western Russia. Mr. Maluchev, chairman of the Government Geological Committee, has pointed out that the greatest demands on geologists have been those of the iron and steel industries; and to meet these he said that hundreds of millions of tons of high-grade iron ore have beeen found in the Magnitaya and Blagodat mountains, and in other deposits in the Urals, which supply the local metallurgical industries, including the Magnitogorsk iron and steel works. Further east the Gornaya-Shoriya and Khakassia districts produce large quantities of iron ore to supply the Siberian iron and steel works.

Manganese ranks high among the vital necessities of war industry, and the Russians are fortunate in possessing, in the Mazul deposits, sufficient supplies of this metal to cover the large requirements of the Siberian metallurgical industry almost completely; the requirements of the Ural territory are met chiefly from the Polunochnoye mines. New and important sources of fireclay and other essential materials have also been discovered.

New Vanadium Ore

During the past two years a number of easily worked sources of molybdenum, tungsten, mercury, tin, antimony, etc., have been discovered; also very large deposits of what appears to be a new variety of vanadium ore. In Aldan valuable supplies of mica are now available. Raw material, presumably bauxite, for the aluminium industry, has been discovered in Central Asia, in the Urals and elsewhere. In the Kazakhstan Republic more than 150 geologists are prospecting for minerals; a detailed hydrographical map is nearly completed, also a map showing deposits of iron ore, non-ferrous metals, and other raw materials.

U.S. Metallurgy

Miners' Bureau Laboratory Work

THE metallurgical laboratories section of the U.S. Bureau of Mines is engaged in developing new and improved methods of producing strategic metals and in working out methods of obtaining such metals from new sources. Work is in progress on methods for the recovery of vanadium from the extensive deposits of very low-grade ore that have recently been discovered in Wyoming and Utah. Two new processes, known as the "nitrogen dioxide" and the "dithionate" processes, for extracting manganese from low-grade ores are being investigated on a pilot plant scale. Other investigations of this nature include studies on the production of electrolytic manganese; recovery of nickel, chromium, and iron from Washington ores; and production of magnesium metal from magnesium oxide. The alloy and metallographic laboratories of the Bureau are engaged in studying the possibility of extending the use of manganese alloys, particularly for war purposes. They are also working on methods of eliminating impurities encountered in special manganese alloys, and developing any alloys of other metals which promise to have important applications in the present emergency. This department helped to develop the alloy of manganese, silver, and copper now being used in the war-time five-cent coin. Electrolytic manganese produced by the Bureau through its own process is now being used in this coin. Much of the same high purity metal has been shipped to England as a part of the lend-lease agreement.

MANGANESE ORE IN PALESTINE

A section of the recent report of Dr. A. Lohnberg, of Jerusalem, on mineral prospecting in Palestine refers to manganese deposits. It states that the occurrence of this ore was first mentioned in G. S. Blake's Report of 1939 on Geology, Soils and Minerals. In 1940 Mineral Supply, the organisation set up to accept orders for delivery of minerals on behalf of Palestine manufacturers, started for the first time to exploit this deposit in order to meet an urgent demand for manganese dioxide in the production of batteries, welding electrodes and black paints in Palestine. The ore so far mined has contained between 55-75 per cent. of MnO_2. Mr. S. H. Shaw, the Palestine Government geologist, assisted in the exploration of this manganese deposit and found an extension of it at some distance from the main deposit. Although the occurrence is situated in an outlying area its further exploration is under consideration.

Personal Notes

In connection with his researches in enzyme chemistry, the American biochemist, PROFESSOR F. F. NORD, of Fordham University, New York, has received a grant of $7500 from the Rockefeller Foundation.

Four chemists are included among the thirty-six new academicians of the U.S.S.R. Academy of Scientists. They are PROFESSORS DUBININ, NESMEYANOV, RODIONOV and CHERNYAYEV.

MR. W. M. LARKE, son of Sir William J. Larke, K.B.E., has been appointed works manager of the Bilston Iron and Steel Works of Stewarts & Lloyds, Ltd., in succession to MR. ALBERT WRIGHT, who has retired.

MR. A. L. BACHARACH has been appointed hon. associate editor of *Chemistry and Industry*, while Dr. Stephen Miall retains full editorial responsibility for the S.C.I.'s journal. Mr. Bacharach has demonstrated his literary skill not only in his writings on technical matters but also in his non-scientific books, *The Musical Companion* and *Lives of Great Composers*.

The honorary degree of Doctor of Science was conferred on DR. E. V. EVANS at Leeds University last week. Professor D. T. A. Townend, Livesey Professor, introducing Dr. Evans, described him as one of the gas industry's most distinguished figures, and referred to the University's long association with this industry which led to the endowment of the Livesey chair. On the same occasion an honorary LL.D. was bestowed on PROFESSOR H. S. RAPER, Professor of Physiology at Manchester.

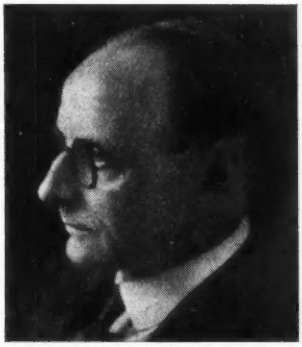
An exploratory committee has been appointed by the Council of the Society of Chemical Industry to consider the possibilities of forming an English-speaking chemical union. It includes DR. E. K. RIDEAL, MR. F. P. DUNN, MR. C. S. GARLAND, DR. J. B. PHILLIPS (of the Canadian Department of Munitions and Supplies), MR. G. B. GRESFORD (of Australia), and the society's honorary officers. The committee is instructed to report after consulting kindred societies and the Chemical Council.

MR. ALBERT GEORGE HIGGINS, M.Sc., A.I.C., has been appointed assistant secretary of the Institution of Gas Engineers. He has been in the service of the South Metropolitan Gas Company for 14 years, and has had experience in the central research laboratory and the works laboratories. He was for four years a lecturer in Gas Engineering (Manufacture) at the Sir John Cass Technical Institute. Mr. Higgins is a Fellow of the Illuminating Engineering Society and a Barrister-at-Law of the Middle Temple.

PROFESSOR HARRY MELVILLE, who has succeeded Professor Findlay as professor of chemistry at Aberdeen University, last week devoted his inaugural lecture to plastics and other synthetic materials. Professor Melville, it may be recalled, is a member of the committee of the S.C.I.'s Plastics Group.

Among the American trade unionists coming to this country under the exchange-visits scheme arranged by the Office of War Information is a chemical worker, MR. OTTO BUTLER. An employee of the Monsanto Chemical Co., East St. Louis, Illinois, Mr. Butler is a member of the Chemical Workers' Union, which is affiliated to the American Federation of Labour.

DR. P. C. C. ISHERWOOD, O.B.E., F.I.C., who was elected chairman of the Association of British Chemical Manufacturers at the recent general meeting, is chairman and managing director of W. J. Bush & Co., Ltd., the well-known makers of fine chemicals and distillers of essential oils. Dr. Isherwood has served on the Council of the



Dr. P. C. C. Isherwood, the new Chairman of the A.B.C.M.

A.B.C.M. for 23 years, and has been with W. J. Bush & Company since 1901. He studied at the universities of Heidelberg and Würzburg, being at the latter a pupil of the late Professor Hentzsch, in chemistry, and Professor Röntgen, in physics; and he took his doctorate there. For two years he held a Fellowship for Higher Chemical Research at the Central Technical College, South Kensington (now incorporated in the University of London). The first part of his business career was in the heavy chemical industry, and he was employed by the United Alkali Company, and later by Brunner, Mond and Company, before serving with his present company. Shortly before the last war, Dr. Isherwood interested himself in the problem of the manufacture of electrolytic zinc from refractory zinc-lead

ores, and erected and operated a pilot plant in the U.S.A. In 1916, owing to the shortage of pure zinc for war purposes, he erected and operated a plant in this country, under his own patents, at Widnes. In addition to his position in the A.B.C.M., he is a member of the Grand Council of the Federation of British Industries, and of the Advisory Council for Plant and Animal Products of the Imperial Institute, where he is also chairman of the Committee on Essential Oils and Resins. He is chairman of the British Essence Manufacturers' Association, and of the Essential Oils Section of the London Chamber of Commerce.

Obituary

MR. JOHN WILLIAM CLIBBORN, whose death in Glasgow at the age of 69 was reported recently, was, prior to his retirement in 1935, manager of the St. Rollox Works of I.C.I. (Alkali), Ltd. He had also served for many years as secretary of the Sulphuric Acid Association of Scotland. He was a native of Widnes, Lancs., and entered the chemical industry at the Golding Davis works in that town.

MR. WILLIAM DOUGLAS, F.I.C., died at Berkhamstead on October 29 at the age of 77. A chemical engineer specialising in sugar technology, he joined the Demerara Co., Ltd., of British Guiana, in 1885. He later became control chemist of this company, and in 1912 he was appointed a director, retiring from this position in 1937. He had been associated with the Institute of Chemistry since 1888, in which year he was also elected a fellow of the Chemical Society. For many years he was a member of the Society of Chemical Industry.

MR. ALEXANDER MILLER MCKECHNIE, who died at Gateacre, near Liverpool, on October 24, aged 77, was chairman of McKechnie Brothers, Ltd., of Widnes and Birmingham, manufacturers of sulphate of copper and lithopone (at Widnes), and of extruded brass forgings, etc. (at Birmingham). The original works at Widnes were founded by Mr. McKechnie and his two brothers over 50 years ago, and the late chairman was a greatly respected figure both in the chemical and metallurgical world. Many members of the family and of the staff of the company were present at the funeral at Allerton on Wednesday last week, and Mr. W. Mowe attended as representative of the British Sulphate of Copper Association.

New Control Orders

Coal-Tar Products Prices

THE Coal-Tar Products Prices Order, 1943 (S. R. & O. 1943, No. 1528, price 10d.), dated October 20, revokes the Coal-Tar Products Prices Order, 1942, and comes into force on November 15. Its provisions are substantially the same as those of the 1942 Order, except that in cases where the Minister of Fuel fixes an increased or reduced price for special reasons, in substitution for the price specified in the Order, any increase or deduction so fixed is attracted to the maximum price. No increase in the specified price may be authorised unless the amount of every increase is shown on the invoice relating to the supply.

The definition of " road tar " has been revised to cover any substance at least 90 per cent. of which consists of the residue from the distillation of coal tar supplied as material for use in connection with the construction or maintenance of roads, etc.

Certain price increases are allowed if coal-tar acids as specified in Art. 53 of the Order are supplied by persons other than distillers. Transport costs have been amended to provide that the cost attributable to the transport of coal-tar acids from this country to the U.S. shall be calculated on a basis inclusive of water content and pitch residue on distillation.

Part VI of the Order deals with creosote oil sold for the purpose of hydrogenation, including provision for the increase of price of the transport of the oil in certain circumstances. Schedules 12 and 13 set out the grades and properties of the oil so covered. Part VII contains new provisions dealing with coal-tar oils sold for the purpose of timber preservation, benzol absorption, and use in the manufacture of disinfectants, and with strained anthracene oil sold for any purpose. Properties and methods of test for coal-tar oils and strained anthracene oils are given in Schedules 18 and 19. Schedules 1 to 12 and 14 to 17 set out the prices for the various coal-tar products covered by the Order.

Synthetic Rubber Imports

The Treasury has issued the Import Duties (Exemptions) (No. 4) Order, 1943 (S. R. & O. 1943, No. 1487), exempting from general *ad valorem* duty certain forms of synthetic rubber. The Order came into operation on November 3.

A series of questions on Anglo-German trading relations have been tabled in the House of Commons. Mr. Ellis Smith (Lab., Stoke) is asking what proportion of the shares in I.G. Farben and its subsidiaries are still controlled by Germans, and is alleging that I.G. carried on world trade through an American organisation until the U.S.A. entered the war. Mr. N. Maclean (Lab., Govan) is to inquire as to the relations between British firms and Metallgesellschaft.

Fuel Economy in the Chemical Industry

(*Continued from p.* 468)

of mechanically agitating this layer, *e.g.*, by mechanical stirring, by a scraper, or by a spiral arrangement, or by rotating the nest of tubes to produce the necessary scraping?

A. Mechanical agitation would certainly increase the rate of heat transfer but it would be difficult to apply to the outside surfaces of a tubular condenser. It is very doubtful whether this increase would justify the added complication in most plants.

Q. In vertical condensers having very low rates of flow, small gas or air bubbles form in the tubes and act as centres of corrosion. How can this be avoided? The scraping mentioned in the last question may be the solution.

A. The answer is really the same as that to the previous question. Very often, however, the velocity can be increased by exercising a little ingenuity, without exceeding the allowable pressure loss or hampering the accessibility to cleaning.

Q. Is not the answer that it is extremely difficult to obtain turbulent flow in condensers, particularly condensers dealing with gas-water-tar mixtures, because the condensed fluids flow down the surface? Very large condensers are necessary for this reason, for example, in cooling raw producer gas.

A. (1) As mentioned before, the flow on the cooling liquid side is too often not turbulent. Streamline flow gives very much lower rates of heat transfer; the calculations, moreover, are difficult and the result unreliable. The other half of the question refers to the condensing vapour side. The transfer here may be very poor if there is more than a small amount of inert gas present, and the worst possible condition is when the major part of the duty is the cooling of the uncondensable gas in the presence of vapour. Heat-transfer rates to gases are so very much lower than to liquids and, in addition, in the instance mentioned, the surfaces are blanketed with a comparatively stagnant film of liquid. One questioner has asked, what is the effect of vapour velocity? If it is a matter of pure condensation, without the presence of uncondensable gas, vapour speed has little effect, but in gas cooling a high velocity is most important for economy of surface.

A. (2) (Mr. Vigers). Referring to an earlier question, we have found it pays to put a small coil into a vessel with a stirrer. As Staybright steel has a limited life, it is cheaper to run a small motor and a little stirrer and have a cheap coil which can be replaced easily, than to design the heat exchanger with large surfaces with mechanical circulation and be very much more expensive to replace in a few months.

Q. Can advice be given on the construction of heat-transfer surfaces for chemical products, b.p. 105° C., that act similarly to sulphuric acid between 15 per cent. and 70 per cent. strength, including H_2SO_4 of those concentrations? Lead is the obvious first choice, but under the repeated heating and cooling that is necessary it breaks down. The only improvement we have been able to make in the use of lead is by striving after greater simplicity in design and having renewable surfaces. Can such a vessel be made in ferro-silicon in a reasonably practical engineering manner? Has a dismantlable type ever been designed? The problem arises at all temperature ranges from 10° C. to boiling point.

A. Notice was asked to look into this question before giving an answer.

Q. Heat transfer depends, among other things, on the velocity of the liquids in the exchanger, but velocity means power. Is there an economic limit regarding the increased heat transfer and the power required for the increase?

A. Usually, power costs are comparatively low but, on the other hand, it rarely pays to limit the amount of surface at the expense of pressure loss. The allowable pressure drop is more often settled by factors other than power consumption, such as thickness of pipes and heat exchangers, size of pumps, type of joints, and the general inconvenience of high pressures. All these factors must be co-ordinated to find the economic limit. Rate of heat transfer varies in general, for turbulent flow, as $(\text{velocity})^{0.8}$ and pressure loss as $(\text{velocity})^{1.8}$, so that pressure loss increases at a far greater rate than heat exchange.

Surplus Heat Utilisation

Various speakers gave examples of the utilisation of surplus heat:—

(1) A gas company heating its offices and buildings by the hot water leaving the primary condensers.

(2) When small crystals are saleable, great economies in heat can be made by shock circulation of the water and shock cooling, if the crystallisable liquid is passed through a heat exchanger at a velocity sufficiently high to prevent deposition of crystals on the cooling surface.

(3) The use of flash steam for heating at lower pressure and temperatures.

(4) An auxiliary economiser operating on boiler-flue gases and providing hot water for washing; the danger of corrosion through condensation from the flue gases was mentioned.

(5) An auxiliary air heater used as in (4), by which the hot air is provided for the entire production of a dried product from the factory. Auxiliary steam heaters are installed as a standby. C.I. heaters are used and the hot air is at 100°C. It was suggested that homogeneous lead lining would provide the necessary protection against corrosion—but at present it is too expensive in first cost.

General News

From Week to Week

The Parliamentary and Scientific Committee is setting up a sub-committee to consider the relation of income tax to research expenditure.

Synthetic Resins, Ltd., Cheshire Street Works, Mossley, Manchester, have been elected members of the Manchester Chamber of Commerce.

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users during the four weeks ending November 27.

An exhibition illustrating new uses which have been found for glass has opened at the Sunderland Art Gallery. It has been organised by the Department of Glass Technology of Sheffield University.

The report on research and the universities, prepared by the Parliamentary and Scientific Committee, is now available as an 18-page pamphlet, price 1s., from the committee's headquarters, Courtfield House, Courtfield Road, London, S.W.7.

The insecticidal properties of inert dusts were discussed by Professor H. V. A. Briscoe, in his Cantor Lectures, of which we published a summary in our issue of May 29 (p. 582). The lectures have now been printed in full in the *Journal of the Royal Society of Arts* (1943, *91*, 4650, p. 593).

The metal filter pump advertised by Baird & Tatlock (London), Ltd., in our issue of October 16, has been reduced in price from 10s. each and 108s. per dozen to 7s. 6d. each and 81s. per dozen. The makers explain that this reduction has been made possible by mass production.

Nylon as gut-substitute is to be available next year to fishermen. This news was given by Commander Collard, of the Ministry of Agriculture and Fisheries, at a meeting of the Devon Sea Fisheries Committee last week. He said that the shortage of Japanese gut for mackerel fishing would be made good by nylon produced by I.C.I., Ltd.

Ever since restrictions were placed on paper for publications of all kinds, it has been quite impossible to meet all the demands for copies of THE CHEMICAL AGE. Many anxious to get the journal have long been unable to do so, and although the passing of copies from hand to hand has been a great help, there has always been a large unsatisfied demand. This week the Paper Control announces a slight increase in the paper allocation. All who have hitherto been unable to get copies should communicate with the Publisher, THE CHEMICAL AGE, Bouverie House, Fleet Street, E.C.4. We shall be happy to meet every demand possible within the limited supplies available.

In its colour cards for the spring and summer season of 1944, the British Colour Council is sponsoring a new set of shades for the dyeing of cotton, silk and rayon, and wool. Entitled "Island Colours," these shades and their names are intended to conjure up associations with the South Seas, at the same time remaining consistent with the restrictions imposed by the Dyestuffs Control.

The British Council screened their colour film about Michael Faraday at a Press show at the Curzon Cinema, London, last week. Many of the scenes had been shot in the Royal Institution. The programme also included a picture entitled "Looking Through Glass," which featured the glass research laboratories of Sheffield University. Both films are intended primarily for overseas audiences.

"Fuel Economy Review," published by the Federation of British Industries at 2s. 6d., provides valuable directions for the most economic use of fuels in factories. Specialists with first-hand experience deal with such subjects as instruments for controlling steam generation, thermostatic control, and the use of fuel-economisers. Another article describes the types of furnace in which wood waste can be efficiently burnt.

The Derbyshire Fluorspar Producers' Association, at their inaugural meeting last week, arranged for eight firms to elect a representative each, to act as executive of the association. Officers will be elected and committees formed at the next meeting, which is to take place at Matlock on November 8. The main object of the association is to place the production of fluorspar on a sound basis and to co-operate with the Government Control.

To meet the demand for calcination of "smalls," The Power-Gas Corporation, Ltd., Stockton-on-Tees, has acquired rights from the Ellernan Company of Utah, U.S.A., for the manufacture and supply of their Patented Vertical Lime Kiln. This type of kiln is suitable for the calcination of small limestone ranging in sizes from ¼ in. to ¾ in., built in units each having an output of 5 tons of lime per day of 24 hours.

The Trading with the Enemy (Specified Persons) (Amendment) (No. 15) Order, 1943 (S.R. & O. 1943, No. 1491), contains some 200 additions to, and 100 deletions from, the list of firms, etc., in neutral countries with whom dealings of any kind are unlawful. Additions include: Fabrica de Alcoholes Tunari, Cochabamba, Bolivia; Soc. de Diffusion de Produits Chimiques Spécialisées, Rue Chaillet 7, Fribourg, Switzerland; and Gebruder Sulzer, Zürcherstrasse 9, Winterthur, Switzerland.

Forthcoming Events

At the next meeting of the **Institution of the Rubber Industry,** London section, to be held at the Caxton Hall, Westminster, on **November 8,** at 6.30 p.m., Mr. T. L. Garner, M.Sc., A.I.C., will open a discussion on "GR/S Synthetic Rubber."

Sir Henry Dale's second lecture to the **Royal Institution** on the treatment of infections will be given on **November 9,** at 5.15 p.m., and is entitled "The Beginnings and Growth of Chemotherapy."

At the joint meeting of the **Institution of Chemical Engineers** and the **Society of Chemical Industry** (Manchester Section), to be held at the College of Technology, Sackville Street, Manchester, on **November 9,** at 2.30 p.m., Major V. F. Gloag and Mr. R. J. Barritt will present a paper on "The Manufacture of Sulphuric Acid in Contact Plants."

The annual general meeting of the Microbiological Panel of the **Society of Chemical Industry** will be held in the rooms of the Chemical Society, Burlington House, London, on **November 10,** at 2 p.m. After the business meeting, a lecture on "Fungi as Food," will be given by Dr. J. Ramsbottom, of the Natural History Museum.

A conference on "Problems in the Utilisation of Small Coals" has been arranged by the B.C.U.R.A. for **November 10 and 11,** and will be held at the Institution of Civil Engineers, Great George Street, London, S.W.1. Further details can be obtained from the Conference Secretary, B.C.U.R.A., Rickett Street, London, S.W.6.

A joint meeting of the **Society of Chemical Industry, Royal Institute of Chemistry, Chemical Society,** and **Oil and Colour Chemists' Association** will be held on November 11, at 6 p.m., in the lecture theatre of the King Edward School of Art, King's College, Newcastle-on-Tyne. A paper on "Plastics" will be presented by Dr. P. D. Ritchie, B.Sc., A.I.C., and Mr. I. W. A. Kirkwood, M.I.E.E.

A lecture on "The Use of Plant Growth Substances" will be given to the **Pharmaceutical Society,** at 17 Bloomsbury Square, London, W.C.1, on **November 11,** at 7 p.m., by the head of the Royal Horticultural Society's laboratory, Dr. M. A. H. Tincker.

Chemical and Allied Stocks and Shares

APART from firmness in British Funds and a general rally in home railway securities, inactive conditions have continued to rule in the stock and share markets. There was again little selling, but demand was small. Sentiment appeared to be influenced mainly by uncertainty as to the likely duration of the war and by the vexed question of the extent to which Government controls will be continued after the war. The invariable tendency is for share values to attempt to discount the future a long way ahead; but at the present time it is felt that it is difficult to take more than a short view, bearing in mind the conflicting opinions and assumptions now current in regard to the position and outlook for individual trades and industries after the war.

Compared with a week ago, most movements in shares of chemical and kindred companies have been moderate in character. Imperial Chemical, for instance, were 37s. 9d. compared with 38s. 3d. a week ago, and the 7 per cent. preference units were little changed at 34s. 6d. B. Laporte remained at 80s., and W. J. Bush at 60s. At 47s. British Aluminium were only 3d. down on balance, and Dunlop Rubber have been well maintained at 39s. 6d. at the time of writing. There was a steadier tendency in the units of the Distillers Co., which at 88s. 6d. were little changed on balance. United Molasses were 30s. 9d. xd. Moreover, awaiting the interim dividend announcement, British Plaster Board have remained at 29s. at the time of writing. On the other hand, Associated Cement declined on balance from 64s. to 62s. 6d., and British Oxygen from 78s. 3d. to 76s. 6d. International Paint were 115s. Triplex Glass moved back further from 36s. 6d. to 35s. 6d. Moreover, Murex remained under the influence of the cautious nature of the chairman's remarks, and have declined further to 95s. As in most other instances, however, the decline in price was attributed mainly to absence of improvement in demand; little selling was reported. General Refractories eased a few pence to 16s. 1½d. Despite hopes that the forthcoming results may show that a better trend in earnings has been maintained, Imperial Smelting were not immune from the easier tendency, and were 15s. 3d. compared with 15s. 7½d. a week ago.

There was an easier trend among shares included in the textile section, and Courtaulds moved back from 52s. 6d. to 51s. 9d. On the other hand, hopes that the financial results may show better earnings kept a satisfactory tendency in British Celanese, which, however, subsequently eased to 30s. 7½d. Among plastics, British Industrial 2s. shares were 7s. 4½d., and Erinoid again 11s. 6d. Despite continued market talk of a possible subdivision of the £1 shares into a lower denomination, Thomas De La Rue became reactionary, and, compared with a week ago, declined from 176s. 3d. to 170s. Elsewhere, Greeff-Chemicals 5s. ordinary were 7s. 9d., William Blythe 3s. shares 8s. 9d., Blythe Colour 4s. ordinary 8s. 6d., and Lawes Chemicals 13s. Monsanto

Chemicals 5½ per cent. preference were again 23s. 6d., and Morgan Crucible 5½ per cent. first preference 27s. Major & Co.'s 2s. ordinary shares were around 2s. 6d. Following last year's reorganisation of capital, the latter company has been able to resume dividends with an interim payment of 6 per cent. Burt Boulton remained at 20s. on the second interim payment for the year ended June, which makes a total of 5 per cent., compared with a corresponding distribution of 4 per cent. in the previous year. British Drug Houses were 25s.

An easier tendency ruled in iron and steel securities. Stewarts & Lloyds were 51s. 9d., compared with 52s. 3d a week ago; Tube Investments 92s. 6d., as against 92s. 9d.; Dorman Long 27s. 9d. compared with 29s.; and Staveley 51s. 9d., compared with 52s. 9d. On the other hand, United Steel further improved to 25s. 4½d. Richard Thomas 6s. 8d. units were 10s. 4½d. Elsewhere, Boots Drug at 42s. 3d. were within 3d. of the level of a week ago. Sangers eased to 23s. 10½d. Timothy Whites were 33s. 6d. Among oil shares a better tendency has developed in Anglo-Iranian at the time of writing.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

BRITISH ALUMINIUM CO., LTD., London, S.W. (M.,6/11/43.)—October 18, disposition by trustees of Hans Christian Steenberg and another, with consent of the company, granted in implement of a trust deed dated September 12, 1934; charged on 151 Bo'ness road, Grangemouth. *£3,312,318. April 13, 1943.

DARGUE ACETYLENE GAS CO., LTD., Newcastle-on-Tyne. (M., 6/11/43.)—October 11, £500 charge to W. D. Bell, Newcastle-on-Tyne and another; charged on 70 to 76 (even) City Road, Newcastle-on-Tyne, also October 11, mortgage to Newcastle Portland Permanent Building Society, securing £2,200 and further advances; charged on 70 to 76 (even) City Road, Newcastle-on-Tyne. *Nil. February 20, 1942.

Satisfactions

F. E. RUDMAN & CO., LTD., Radcliffe, chemical manufacturers. (M.S., 6/11/43.)—Satisfaction September 28, of mortgage registered March 15, 1940.

BRITISH ENKA, LTD. (formerly BRITISH ENKA ARTIFICIAL SILK CO., LTD.), London, E.C. (M.S., 6/11/43.)—Satisfaction October 13, of debentures registered October 8, 1925, to the extent of £98,100.

BROOKSIDE METAL CO., LTD., London, E.C. (M.S., 6/11/43.)—Satisfaction October 16, of debentures registered March 20, 1941.

British Chemical Prices

Market Reports

CONTRACTS for most classes of heavy chemicals in London are being steadily drawn against by consumers, and replacement business has been on a fair scale. Values continue on a firm basis in almost every section of the general chemicals market and a moderate volume of new business has been reported, although transactions are restricted by the scarcity of supplies. The soda products generally are an active market, with chlorate and prussiate of soda in short supply, and a good demand is recorded for caustic soda and bicarbonate of soda. Buying of oxalic, tartaric, and citric acids continues to be measured by the quantity available, while the demand for acetic acid remains strong. In the potash section supplies of yellow prussiate of potash are limited, and there is a ready market for caustic potash, permanganate of potash, and bichromate of potash. In other directions formaldehyde is a good market and a steady demand is reported for white powdered arsenic, alum lump, and all grades of glycerine. In the coal-tar products market the pressure for contract deliveries is the chief feature, and a firm price position is maintained.

MANCHESTER.—A generally steady movement into consumption on the Manchester chemical market of the leading soda products has been reported during the past week. The potash chemicals as a whole are being taken up to the full extent of the limited quantities that are available, while a fairly active business is passing in the ammonia and magnesia compounds, and in a wide range of miscellaneous products. The acids generally are active and some continue in restricted supply. The bulk of the current deliveries in all sections is against contracts, though fresh inquiries have been in the market. Quotations as a whole fully maintain their strength.

GLASGOW.—In the Scottish heavy chemical trade there was no change during the past week for home business. Export trade continues to be rather limited. Prices remain very firm.

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3. WORK IN BLACK-OUT AND AT WEEK-ENDS.
4. OPINIONS OF "MEN WHO DO THE WORK"

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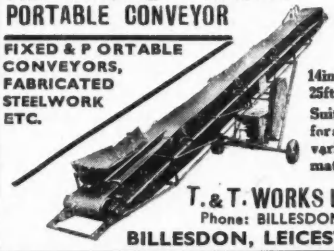

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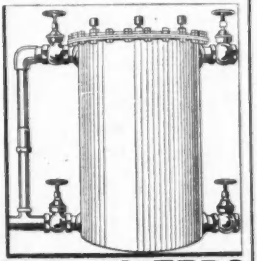

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